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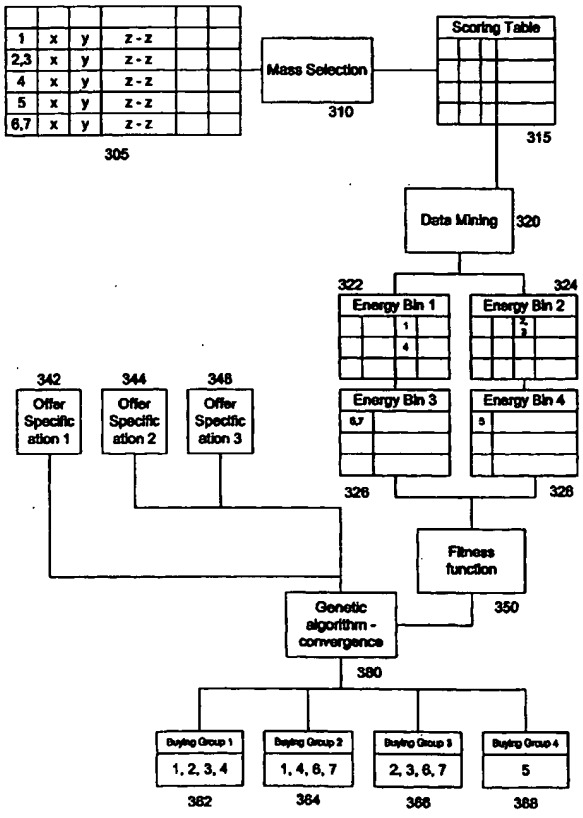
(54) Title: GENETIC ALGORITHM METHOD FOR AGGREGATING ELECTRICITY CONSUMPTION AND OPTIMIZING ELECTRIC BUYING GROUPS



(57) Abstract: The present invention relates to methods of monitoring utility usage and specifically to a system and a method for aggregation of utility users and optimization of such aggregated groups for marketing purposes. A genetic algorithm method (360) of creating electric energy buyers groups (362-368) which are optimized to match electric power sales offerings is disclosed, where each of the buying groups corresponds to a power offering having different energy specifications, including quality, quantity, firmness, availability, and price. The method is applied to the customers of a given utility or power marketer, where the customers are categorized into a plurality of bins (322-328) of varying energy requirements and where buying groups are constructed by selecting customers from bins to match requirements of power offerings. Customers may be choose another power provider at any time, so buying groups can be reoptimized on a daily or monthly basis to take advantage of new power offers.

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GENETIC ALGORITHM METHOD FOR AGGREGATING ELECTRICITY CONSUMPTION AND OPTIMIZING ELECTRIC BUYING GROUPS

This application claims priority from U.S. Provisional Patent applications "ENERGY DESCRIPTORS USING ARTIFICIAL INTELLIGENCE TO MAXIMIZE LEARNING FROM DATA PATTERNS", Application No. 60/156,306, filed September 28, 1999 and "GENETIC ALGORITHM METHOD FOR AGGREGATING ELECTRICITY CONSUMPTION AND OPTIMIZING ELECTRIC BUYING GROUPS", Application No. 60/156,307, filed September 28, 1999, and U.S. Patent Applications "ENERGY DESCRIPTORS USING ARTIFICIAL INTELLIGENCE TO MAXIMIZE LEARNING FROM DATA PATTERNS", Application No. 09/670,895, filed September 28, 2000 and "GENETIC ALGORITHM METHOD FOR AGGREGATING ELECTRICITY CONSUMPTION AND OPTIMIZING ELECTRIC BUYING GROUPS", Application No. 09/672,589, filed September 28, 2000.

Field of the Invention:

The present invention relates to methods of predicting utility customer usage patterns, and specifically to a system and a method for aggregation of utility users and optimization of such aggregated groups for marketing purposes.

Background of the Invention:

Utility companies supply the resources essential to the needs of all industries, including manufacturing plants, hospitals, educational institutions, departments stores, office blocks, farms and homes. While traditionally utilities include such metered resources as water, telecommunications, gas, and electricity, utilities may also include service-oriented utilities such as postal and courier services, moving services, catering, and the like. A thin line has always existed between supplying the best possible level of utility or service to a customer, while maximizing the profit to the utility supplier. Hence for many years, regulation of utilities was the norm. However, deregulation of utility industries has placed increasing demand on utilities to become more attuned to profitability. To this end a utility supplier may choose to segment its total market, identify each segment of the market by some descriptive means, and to tailor the product they may advertise or sell to each segment.

Traditional methods of segmentation and focused marketing rely on simple segmentation of the market by easily identifiable markers such as geographical region, postal code, or estimated customer size. But this crude methodology lacks the sophistication required to identify users, or types of users, by their actual usage of the utility itself. The inability to readily and reliably characterize usage results in considerable wasted expenditure on marketing to what may amount to an unresponsive or economically unsuitable subset of customers.

A suitable or desirable customer may in this context be one whose energy requirements over time best suit the goals of the utility company in maximizing usage, minimizing overhead, and increasing profits. In this manner a particular group of desirable customers may actually include a variety of distinctly separate types of consumers, such as schools, hospitals and homes. Their commonality is that their actual pattern of electric usage is of particular interest to the company. Other factors such as their type of industry are of lesser concern.

Particularly, to take the example of the electrical utility industry, there is a common goal of being able to match power offerings to particularly well suited customers. The traditional methods lack the reliability of creating such customer groups. So time and money is wasted marketing to groups which ultimately even if they choose to purchase the product do not provide the company with the desired energy supply preferences.

The recent moves towards deregulation of the electric markets in the U.S. will lead to freedom of consumer choice of power supplier by 2002. The players in this deregulated power industry, the utility companies themselves, must ideally have knowledge of their consumers' energy usage patterns in order to sell energy to them. Presently, however the former monopoly utilities have all the energy data, originally collected from consumers' electric meters for billing purposes. This situation forces other, perhaps much smaller or newer, utility companies to compete at a disadvantage, in effect having to guess the characteristics of their target market before beginning to market

their product there. Clearly, this puts them in a weaker position when competing against the larger former monopolies. The smaller utility companies would benefit greatly from a system that supplies them with information that enables them to level the playing field and to survive in an increasingly competitive marketplace.

Additionally, all utility companies, both large and small, need to be able to accurately estimate the periodic (for example monthly, daily, hourly) usage patterns of their customer population so as to best market their customer product offerings and match them to available resources. To date, the optimum way of doing this has been to install a time-of-use meter in each customer's home, and monitor it closely. Since such a process is time-consuming and, in large-scale environments, prohibitively expensive, most utility companies do not have accurate estimates as to their customer usage. Such utility companies would benefit greatly from a system that supplies them with accurately estimated information as to their customer usage on, say, a per-minute or per-hour basis, without the cost normally associated with obtaining such information.

Summary of the Invention:

The present invention addresses the need for utility companies to accurately estimate the energy usage characteristics of their target population and tailor product offerings to groups of users. A genetic algorithm method of creating electric energy buyers groups which are optimized to

match electric power sales offerings is disclosed, wherein the power offering includes energy specifications such as quality, quantity, firmness, availability and price. The method is applied to the customers of a given utility or power marketer, and the customers are categorized into a plurality of bins of varying energy requirements. Buying groups are constructed by selecting customers from bins to match the requirements of the power offerings. Customers may switch power provider at any time, so to account for this the buying groups can be recreated to take advantage of such customer migration. In one embodiment the inventor comprises a method of grouping members of a population of consumer types into buying groups for the purpose of making an offer to purchase a utility service, comprising: reading energy usage bins; reading an offer specification; and, placing members of said population of consumer types into buying groups.

In another embodiment the invention comprises a method of grouping members of a population of consumer types into utility buying groups, comprising: categorizing said members into a plurality of utility usage bins, and placing members of said population of consumer types into buying groups constructed from members in said bins to optimize each buying group to a utility sales offering.

In another embodiment the invention comprises a method of grouping members of a population of consumer types into utility buying groups, comprising: categorizing said members into a plurality of utility usage bins, generating a fitness function with

adjustable weighting factors to the requirements of a series of utility sales offers, assigning a first generation of members into buying groups, evaluating the fitness function, creating the next generation of members and placing them into buying groups, and repeating the process until the fitness function indicates that the buying groups are converged to optimally match the utility sales offers.

Brief Description of the Drawings:

These and other features and advantages of the present invention will become more apparent to those skilled in the art from the following detailed description in conjunction with the appended drawings in which:

Figure 1 is a flow chart showing an embodiment of a method of the invention illustrating how a database of customers with stored usage patterns is aggregated into usage bins.

Figure 2 is a flow chart showing an embodiment of a method of the invention in which usage bins are used to generate customer marketing groups.

Figure 3 is a block diagram of an embodiment of the invention showing how a database of customers, with stored usage patterns is aggregated into usage bins which are then used to generate customer marketing groups.

Detailed Description of the Preferred Embodiment:

A method of creating electric energy buyers groups which are optimized to match electric power sales offerings is hereinafter

disclosed. In one embodiment, a power offering includes energy specifications such as quality, quantity, firmness, availability, and price. The method may be applied to the customers of a given utility or marketer. According to the method, customers are categorized into a plurality of bins of varying energy requirements. Buying groups are constructed by optimally selecting customers from these energy bins to match the requirements of such power offerings. In practice customers may switch their power provider at any time, so the method of the invention allows for the buying groups to be recreated on a regular basis to take advantage of new customer populations and new power offers.

An embodiment of the invention uses a **genetic algorithm** to model and optimize the creation of the buying groups. Genetic algorithms are optimization methods based on the principles of evolution. The development of such algorithms are known to one of skill in the art. The primary goal when using a genetic algorithm is to combine all possible components of the model in the most optimal way. In one embodiment, energy operators are used to provide an effective genetic algorithm representation of the model. In the context of the invention, energy operators are energy usage parameters associated with a particular customer type. A number of possible solutions (i.e. which correspond to chromosomes in genetics terminology) are generated. To continue the genetics analogy each chromosome consists of a number of genes. In the method disclosed herein each gene represents a distinct customer usage pattern.

A **fitness function** assigns each new chromosome a fitness value which affects its probability of selection during the evolutionary or convergence process. The term fitness function, and the derivation of such fitness functions, is known to one of skill in the art. In the context of the invention, the fitness function may comprise a number of energy operators and their correlation with a chosen offer specification. The variables that effect the fitness function can be adjusted and may include the quality, quantity, price, and the **firmness**, or degree of reliability of the power offer.

During each iteration (or evolutionary step) the genetic algorithm splits strings of genes from two chromosomes and swaps them, creating child chromosomes. This method allows the model to consider diversity while still keeping some linking between genes. A new population is made from the children, and the process continues. After each evolutionary step, a score is assigned to each chromosome by evaluating the fitness of each chromosome against the fitness of the whole population. The fitter a chromosome the higher its score and the greater its chance of selection and propagation.

The genetic algorithm described continues processing until the whole population converges, which in the context of the invention results in the method providing the fittest or the most likely set of profile-mix solutions that satisfy the requirements of the fitness function. The genetic algorithm process also optimizes the number of buying groups given the fitness function, with regard to the available customer population and power offers in the market.

GENERATION OF USAGE BINS

In one embodiment of the present invention, selection techniques are used to categorize and weigh customers' electric usage load shapes. Each customer is also evaluated using line breeding filters to determine the extent of true-breeding, i.e. the predictability of energy use over different time periods and seasons. The system uses data mining techniques to place customers into bins with distinctly different energy requirements. A randomly selected first generation of customer assignment into buying groups is evaluated, with succeeding generations produced according to genetic techniques, until convergence to the optimum buying group assignment is reached.

This process assigns most customers to a buying group that corresponds to a particular power sales offer. In some instances, some customers may be assigned to buying groups that do not fit any of the current sales offers. An operator may then locate alternative power offers for this set of customers.

The method may also be applied to the reverse situation, i.e. to choose and aggregate the optimal set of power bids based on buyer group energy requirements where bids are used as the driving criteria in the fitness function and power sales offers are aggregated and optimized to match the energy requirements. In this particular embodiment, the customer groups are already known and are kept fixed, while a genetic algorithm is used to develop appropriate power sales offers for the group.

Figure 1 describes an embodiment of a method of the invention based on a genetic breeding analysis technique, for

evaluating and optimally classifying business and residential electric users to receive electric product offers. As illustrated in Figure 1, an **energy library** is first evaluated in step 105. As disclosed herein the energy library comprises a series of entries or profiles, one profile for each input customer type. Each profile includes associated **usage parameters, key usage predictors**, and a **load shape** for that customer type. The usage parameters may comprise such variables as maximum energy requirement, total energy usage, and load factor. A key predictor may be any quantitative or qualitative parameter or variable associated with a particular customer, the value or state of which is a strong determinant of that customers usage pattern. Examples of key predictors may include geography, postal code, climate zone, and Standard Industrial Code (SIC). The SIC Code (and its counterpart the NAICS) is a code allocated by the US Office of Safety and Health Administration (OSHA) to each business in the United States. Other forms of business classification are used in the United States, with similar classification systems used in other countries. The SIC code (or simply SIC) describes to a high degree of precision the type of industry a particular customer belongs to. Key predictors are determined by a process of modeling and statistical analysis applied to representative populations of energy users. The creation of both the energy library and the key predictors is described in detail in co-pending application serial no. 09/670,895, entitled "ENERGY DESCRIPTORS USING ARTIFICIAL INTELLIGENCE TO MAXIMIZE LEARNING FROM DATA PATTERNS", filed September 28, 2000 and incorporated by reference.

The load shape is an indicator of that customer type's energy usage over an extended period of time, for example a calendar year. In some embodiments the load shape is precise to an hourly interval. According to the present method the individual load shapes in the energy library are evaluated in step 110 through a genetic modeling process. In one embodiment of this process a series of mass selection and line breeding filters, which assign weights and variables that describe load shapes in terms of genetic fitness statistics are used to analyze the entries. The process causes the entities to be spread over a spectrum of load shapes, with those having higher weight loadshapes at one end of the spectrum and those having lower weight loadshapes at the other end. The result of the analysis is a scoring table comprising an entry or record for each business or residence. Each individual record is tagged with weights and variables from the analysis.

The scoring table is then analyzed in step 115 using data mining techniques which may include cluster analysis, tree analysis, and discriminate analysis. The data mining techniques separate out the customer on the basis of their energy requirements, energy patterns, and weights. Those customers with similar energy usage are sorted into energy bins.

BUYING GROUPS

In a particular application of the invention, the energy bins created earlier are further used to create energy buying groups. Grouping current or potential customers into buying groups allows that group of customers to take advantage of volume discounts

that may be offered to such groups, and results in lower energy prices across the board by creating aggregated load shapes that are more efficient and desirable to the utility company. The aggregate load shapes for the buying groups are optimized using genetic algorithms and other statistical methods that optimize load shapes to better match energy power sales offers.

As illustrated in Figure 2, energy buying groups are developed from energy use similarity bins from which individuals are selected to be added to the buying group. In step 205 energy information about a set of energy usage bins is first read into the system. This information may be created as described in steps 105-115 above, by analyzing a business intelligence library using mass selection or some other technique.

In step 210, a fitness function is applied to the data. The fitness function is a mathematical description of a range of power sales offers. The initial development of the fitness function requires scored power offers, derived from a weighted function of the energy profile, quality, quantity, firmness, price, and availability. The fitness function thus correlates independent data, in this instance the power sales offer, with dependent data, the members of the buying groups.

In step 215, scores are assigned to each offer, which are later used to select the best set of offers for a chosen period of time. The chosen power offers are the fitness function to which the buyer's groups will be developed and optimized in step 220 using the genetic algorithmic process. Each generation, or iteration, of aggregated individuals is scored for fitness against a

range or power sales offers in the market for a given point in time to create a series of buying groups 225. Each buying group will be matched to a specific power offer, or set of power offers.

Some buying groups may be formed even if the consumer entities therein do not match any of the power sales offers. These buying groups are not considered further by the system, but a record of such groups and their constituent members is automatically generated by the system. This information can be later used to find power offers specifically tailored to suit their energy requirements. In one embodiment, a reverse variant of the method can be used, wherein the population of the groups are fixed and the power offers are optimally generated according to the fitness function, to find appropriate power offers.

Buying groups may be split or re-optimized on a regular basis, for example daily or monthly, to take advantage of new power offers or consumer migration. Since the buyer's groups created by the method may be easily altered in response to changes in the consumer mix and the power availability, they are of great use to a utility company in estimating market demand for their product, and tailoring their product appropriately.

In other embodiments of the invention, optimally flat buying groups may be created without regard to any set of actual power offers. This can be achieved by combining utility users that may have very different load shapes, load usage, and periods of peak demand, but which when combined and evaluated over a chosen time period their differences in usage compensate for one other and the usage of the group as a whole is substantially

constant or "flat". The profiles of such buying groups include load shapes which indicate substantially the same aggregate energy use for that buying group for each period of time (for example, each hour in the day, each month of the year, or each season). A user, which in this context includes utility companies having many individual customers, may use this buying group information as an aid in shopping for power offers from power suppliers, including other utility companies or standalone power generators.

This same technique may be used to optimize the distribution of a utility's resources over many users. By placing users into a customer group such that their aggregate load shape is substantially flat, a utility company can accurately estimate their aggregate power demands. The utility company may redistribute customers within groups as needed to ensure level demand curves over time.

Figure 3 illustrates an example of a system which incorporates the method described above and applies it to a population of customer entities. The energy library 305 initially contains information about the demographic and usage patterns of each customer entity together with the key predictors that determine that entity's usage. For example the energy library may include information about the following customer entities.

1. Private house
2. Apartment Ccmplex
3. Apartment complex
4. Small business
5. Department store
6. School
7. School

Customer entities 1,3 and 4 all have energy usage pattern / load shape A as determined by their type profile in the energy library, customer entity 2 has load shape B, customer entity 5 has load shape C and customer entities 6 and 7 have load shape D.

The members or profiles in the energy library are grouped by mass selection techniques 310 which cause the profiles to be evaluated relative to each other according to their characteristic energy usage. Key predictors 305 can be used to enhance the mass selection process by pre-specifying those energy parameters considered most relevant to the power sales offering.

A score 315 is assigned to each profile indicating its relative weight compared to the population as a whole. These scores are then used to create a set of bins 322-328 which differ from each other in having distinct differently energy requirements.

In the example shown in Figure 3, the system places customer entities 1 and 4 in the same usage bin - which implies they have substantially the same energy characteristics. Customer entity 2 is placed in a separate usage bin. In this manner a set of usage bins is created in which the contents or members of each usage bin are estimated to have similar energy requirements.

The usage bins may then be used to satisfy the requirements of the power offerings. A fitness function 350 is applied to the data. The fitness function is a mathematical description of a series of power sales offers 342-346. The fitness function assigns scores to each offer, which are later used to select the best set of offers for a chosen period of time. The power offers represented by the

fitness function are optimized using a genetic algorithmic process 360. Each generation, or iteration, of aggregated individuals is scored for fitness against the range or power sales offers in the market for a given point in time. When the process converges to within pre-set limits, a series of buying groups 362-368 are created. The buying groups may contain members of widely differing customer entities having different usage demands and demographic attributes. In the example illustrated in Figure 3, one of the buying groups 362 contains customer entities 1, 2, 3 and 4 which are very different in nature, but which individually match the marketing specification. Some buying groups may contain customer types for whom no matching offer is currently available. For example, customer entity 5 is placed into a separate buying group 368. A principal feature of the invention is that it allows the creation of buying groups that are formed independently of the nature of the business or industry performed by constituent members, but in as a combination serve to optimally satisfy the products offered by the utility company.

DISTRIBUTED PROCESSING

In embodiments of the invention, a portion or all of the disclosed method may be performed by a distributed system. Such a distributed system may be based on a local area network (LAN) operating within a single office location, a wide area network (WAN) encompassing several office locations, or an open systems network such as the Internet or the Web.

In one embodiment a system operating the method may be located on a central server accessible via the Internet. Other components such as the mass selection processor, the tags, fitness function and the offer specifications may be located on the same central server, or may be located on other servers in communication with the central server. The central server includes means to allow a user to enter customer data and power offers from a remote location. The system analyzes the information contained within the library and calculates the desired result, which may include for example, the contents of energy usage bins or the contents of energy buying groups. The result is then returned to the remote user.

In other embodiments the artificial intelligence system may automatically retrieve data from remote locations using an Internet protocol such as file transfer protocol (FTP), or another form of dynamic communication protocol. In the context of the application such dynamic communication protocol may include extended markup language (XML), wireless application protocol (WAP), and electronic data interface (EDI). The terms FTP, XML and WAP are common terms known to one skilled in the art. The data thus received may include energy library information, customer usage information, or new customer population information. The system calculates the desired result and returns it to the user via a similar dynamic communication protocol.

Industrial Applicability:

The foregoing description of preferred embodiments of the present invention has been provided for the purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise forms disclosed. Obviously, many modifications and variations will be apparent to practitioners skilled in this art. In particular, it will be obvious that the present invention may be employed in areas other than those related to electrical utilities, i.e. to other forms of utility and service supply that rely on accurate customer information for optimal resource allocation and profit maximization. The embodiments were chosen and described in order to best explain the principles of the invention and its practical application, thereby enabling others skilled in the art to understand the invention for various embodiments and with various modifications as are suited to the particular use contemplated. It is intended that the scope of the invention be defined by the following claims and their equivalents.

Claims:

What is claimed is:

1. A method of grouping members of a population of consumer types into utility buying groups, comprising:

categorizing said members into a plurality of utility usage bins; and,

placing members of said population of consumer types into buying groups constructed from members in said bins to optimize each buying group to a utility sales offering.

2. The method of claim 1 wherein said buying groups may be re-optimized to take advantage of new power offers.

3. The method of claim 1 wherein said step of categorizing said members into a plurality of utility usage bins comprises:

assigning weights to the properties of each of said members; and, weighing said members to determine the usage bin into which they should be placed.

4. The method of claim 1 wherein said step of placing members of said population of consumer types into buying groups constructed from members in said bins to optimize each buying group to a utility sales offering, comprises

(A) generating a fitness function with adjustable weighting factors to the requirements of a series of utility sales offers;

(B) assigning a first generation of members into buying groups;

(C) evaluating the fitness function;

(D) creating the next generation of members and placing them into buying groups; and,

(E) repeating steps (C) and (D) until the fitness function indicates that the buying groups are converged to optimally match the utility sales offers.

5. The method of claim 4 wherein step (B) of assigning a first generation of members into buying groups comprises a random assignment of said members into said buying groups.

6. The method of claim 1 wherein some members are assigned to a buying group that does not match any of the power offers.

7. The method of claim 1 wherein the sales offering includes one of the factors utility price, utility quantity, utility quality.

8. A method of creating utility sales offers for a population of consumer types comprising:

categorizing members of said population of consumer types into a plurality of utility usage bins; and,

placing members of said population of consumer types into utility sales offers groups constructed from members in said bins to optimize each sales offers group to a consumer type bin.

9. The method of claim 8 wherein said step of categorizing said members into a plurality of utility usage bins comprises:

assigning weights to the properties of each of said members; and, weighing said members to determine the usage bin into which they should be placed.

10. The method of claim 8 wherein said step of placing members of said population of consumer types into utility sales offers groups constructed from members in said bins to optimize each sales offers group to a consumer type bin, comprises

(A) generating a fitness function with adjustable weighting factors to the requirements of a consumer type bin.

(B) assigning a first generation of members into selling groups;

(C) evaluating the fitness function;

(D) creating the next generation of members and placing them into selling groups; and,

(E) repeating steps (C) and (D) until the fitness function indicated that the selling groups are converged to optimally match the consumer type bin.

11. The method of claim 10 wherein step (B) of assigning a first generation of members into buying groups comprises a random assignment of said members into said buying groups.

12. A method of grouping members of a population of consumer types into groups having optimally aggregated usage patterns, comprising

categorizing said consumer types into a plurality of usage bins; and,

placing members of said population of customer types into groups constructed from members in said usage bins to optimize each group to best satisfy a fitness function.

13. The method of claim 12 wherein said step of categorizing said members into a plurality of usage bins comprises:

assigning weights to the properties of each of said members; and, weighing said members to determine the usage bin into which they should be placed.

14. The method of claim 12 wherein said step of placing members of said population of consumer types into groups constructed from members in said bins to optimize each group to best satisfy a fitness function comprises

(A) generating a fitness function with adjustable weighting factors;

(B) assigning a first generation of members into said groups;

(C) evaluating the fitness function;

(D) creating the next generation of members and placing them into said groups; and,

(E) repeating steps (C) and (D) until the fitness function indicates that said groups are converged to optimally match the fitness function.

15. A system for grouping members of a population of consumer types into groups having optimally aggregated usage patterns, comprising

means for categorizing said consumer types into a plurality of usage bins; and,

means for placing members of said population of customer types into groups constructed from members in said usage bins to optimize each group to best satisfy a fitness function.

16. The system of claim 15 wherein said means for categorizing said members into a plurality of usage bins comprises:

assigning weights to the properties of each of said members; and, weighing said members to determine the usage bin into which they should be placed.

17. The system of claim 15 wherein said means for placing members of said population of consumer types into groups constructed from members in said bins to optimize each group to best satisfy a fitness function comprises

(A) generating a fitness function with adjustable weighting factors;

(B) assigning a first generation of members into said groups;

(C) evaluating the fitness function;

(D) creating the next generation of members and placing them into said groups; and,

(E) repeating steps (C) and (D) until the fitness function indicates that said groups are converged to optimally match the fitness function.

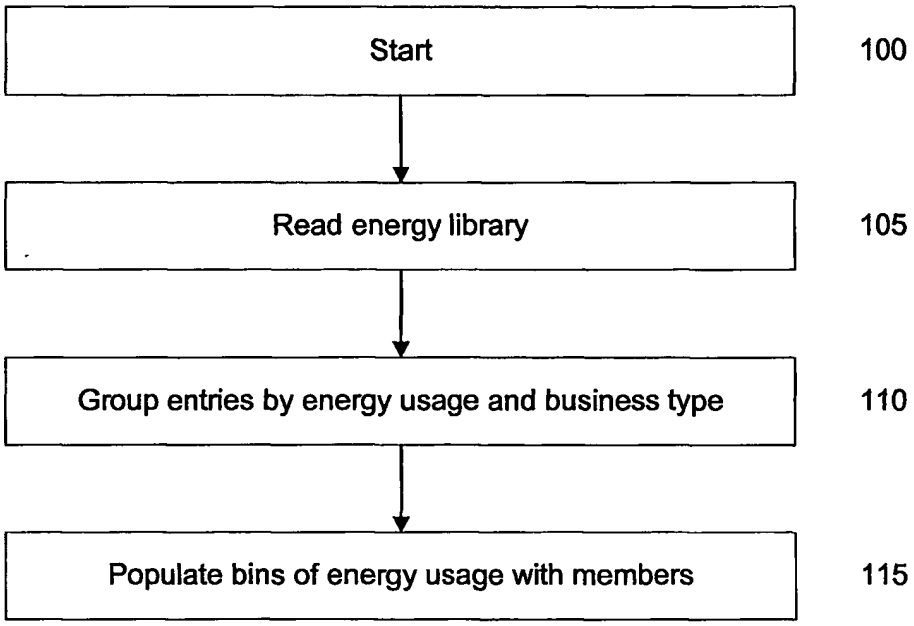

Start
100
Read energy library
105
Group entries by energy usage and business type
110
Populate bins of energy usage with members
115

Figure 1

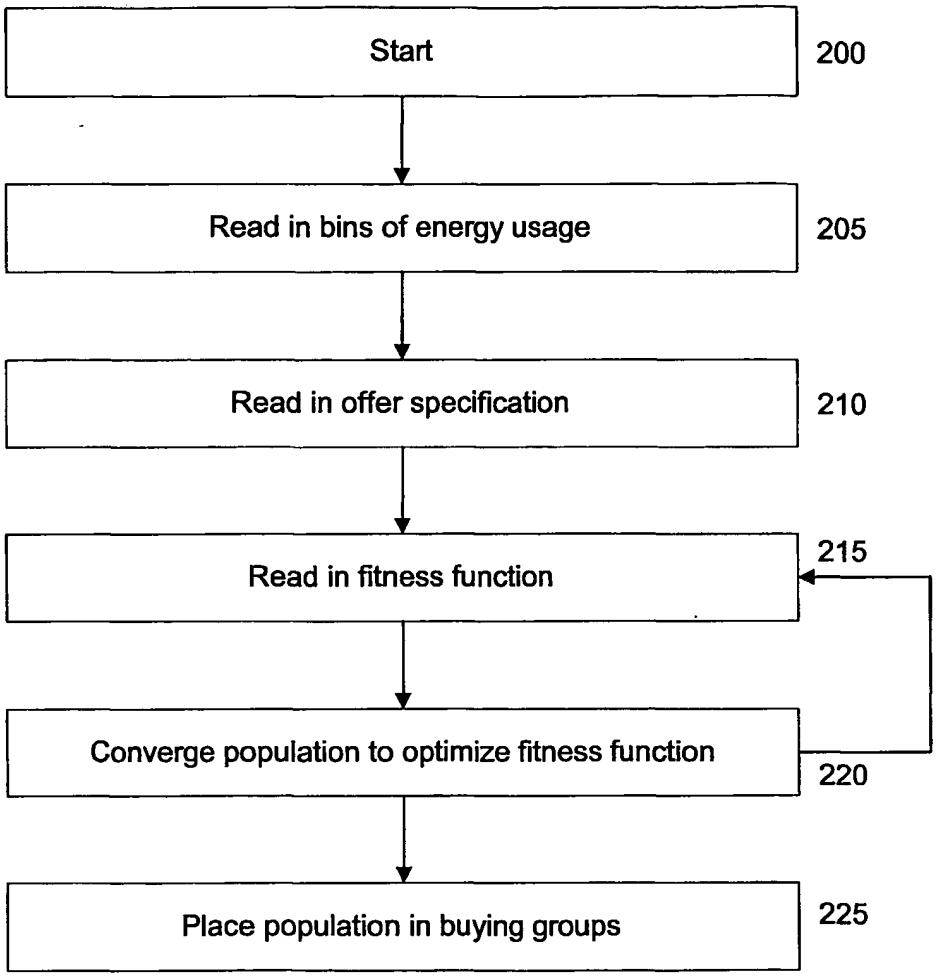
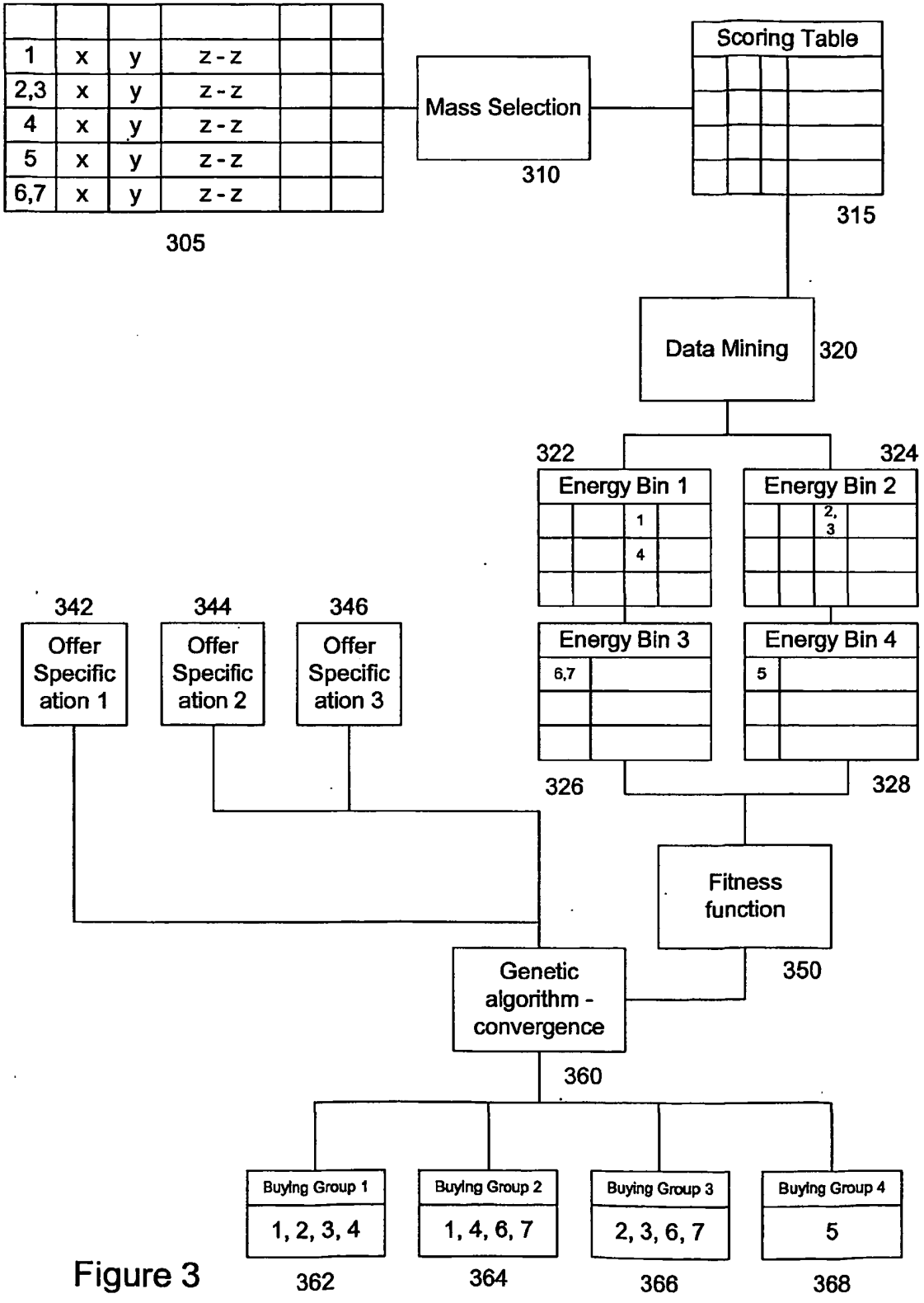

Start
200
Read in bins of energy usage
205
Read in offer specification
210
Read in fitness function
215
Converge population to optimize fitness function
220
Place population in buying groups
225

Figure 2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Scoring Table
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2, 3
Energy Bin 3
6,7
Energy Bin 4
5
326
328
342
344
346
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Offer Specific ation 2
Offer Specific ation 3
Fitness function
350
Genetic algorithm - convergence
360
Buying Group 1
1, 2, 3, 4
362
Buying Group 2
1, 4, 6, 7
364
Buying Group 3
2, 3, 6, 7
366
Buying Group 4
5
368

Figure 3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US01/30513

A. CLASSIFICATION OF SUBJECT MATTER
IPC(7) : G 06 F 17/60
US CL : 705/10
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
U.S. : 705/10

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6,021,402 A (TAKRITI) 01 Feburary 2000 (01.02.2000), column 1, line 5 to column 5, line 19.	1-17
X	US 5,684,965 A (PICKERING) 04 November 1997 (04.11.1997), column 1, line 7 to column 3, line 7.	1-17
X	US 5,572,438 A (EHLERS et al.) 05 November 1996 (05.11.1996), column 1 line 25 to column 6, line 5.	1-17
X	US 5,384,712 A (ORAVETZ et al.) 24 January 1995 (24.01.1995), column 2, line 65 to column 3, line 67.	1-17
X	US 5,963,910 A (ULWICK) 05 October 1999 (05.10.1999), column 1, line 5 to column 12, line 4.	1-17

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:

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Date of the actual completion of the international search
11 January 2002 (11.01.2002)

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